Implementing FlashSystem 840 with SAN Volume Controller

IBM Redbooks Solution Guide

IBM® FlashSystem™ 840 is an all-flash storage array that provides extreme performance, ultra low-latency, high-density, and high-reliability while providing scalable performance in a storage device that is both space and power-efficient. IBM FlashSystem delivers performance that is driven by IBM MicroLatency™ for quick response time and is easy to integrate. FlashSystem 840 uses IBM Variable Stripe RAID™ and two-dimensional (2D) Flash RAID technologies to maintain performance, protect data integrity, and preserve usable storage capacity. IBM System Storage® SAN Volume Controller is a storage virtualization solution that helps increase the usage of existing storage capacity and centralize the management of multiple controllers in an open-system storage area network (SAN) environment.

For clients who want advanced software features, IBM FlashSystem 840 integrated with SAN Volume Controller provides an enterprise-class solution by utilizing SAN Volume Controller functions and services, such as mirroring, IBM FlashCopy®, thin provisioning, IBM Real-time Compression™ Copy Services, and broader host support that enriches any storage environment without introducing any delay or latency. Figure 1 shows the benefits of IBM FlashSystem 840 integrated with the SAN Volume Controller system.

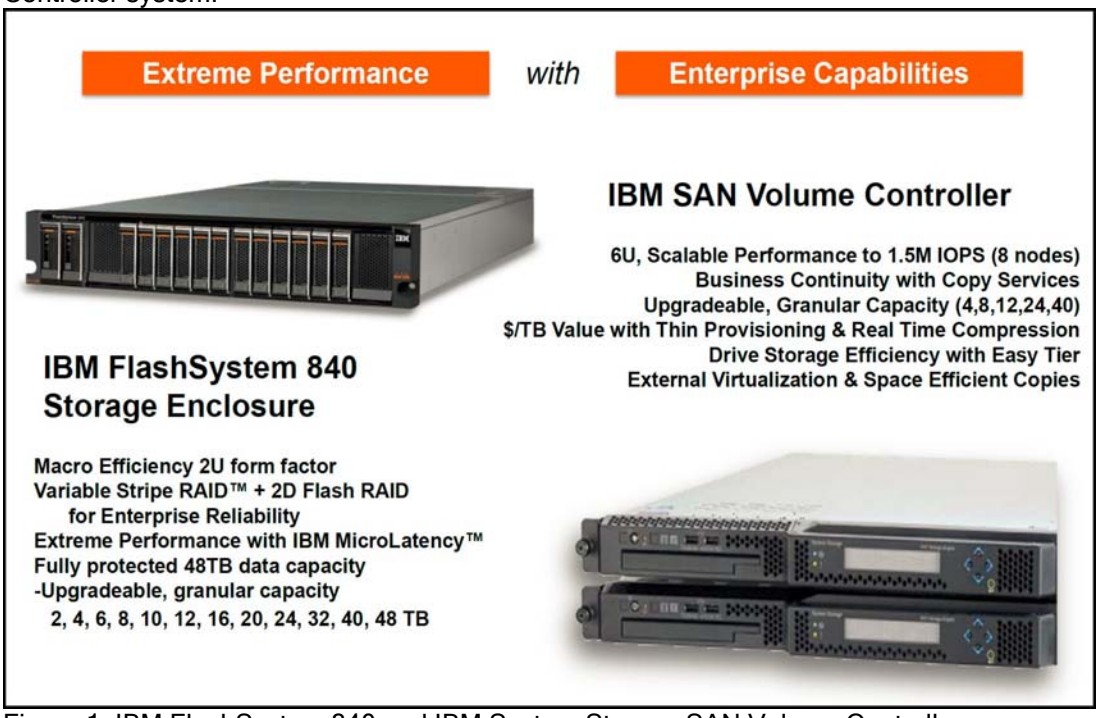

Figure 1. IBM FlashSystem 840 and IBM System Storage SAN Volume Controller

Did you know?

- FlashSystem 840 delivers the lowest latency and the highest IOPS in the market today at an economical price.
- FlashSystem 840 offers enterprise-level availability and reliability with no single point of failure, multiple layers of data correction, chip redundancy, and redundant hot swappable components.
- The FlashSystem 840 graphical user interface (GUI), which is based on the SAN Volume Controller GUI, provides simplified management that results in 4.8x faster setup than the prior generation of GUI.
- Integrating FlashSystem 840 with SAN Volume Controller can increase storage performance as much as 2x.
- You can order FlashSystem 840 individually and integrate it with a SAN Volume Controller in your environment, or for advanced software features, order the IBM FlashSystem V840.

Business value

Today's global organizations depend upon the ability to unlock business insights from massive volumes of data, and they need to be able to do it faster than the competition. By eliminating storage bottlenecks, flash technology redefines the performance, efficiency, and reliability of data-intensive applications. IBM flash storage offerings provide extreme IOPS performance in a power-efficient footprint. I/O performance is critical for applications such as read-intensive databases, SAP, and virtual desktop infrastructures (VDI).

Although you can improve performance by using faster processors and faster systems, data must still be read from and written to storage. Traditional hard disk drive (HDD) storage cannot provide the speed that is required by many applications. Many solid-state drive (SSD) solutions add latency because software is required to manage access to flash memory. Using FlashSystem 840 with an all-hardware data path that uses field programmable-gate array (FPGA) modules, which are engineered to deliver the lowest possible latency, combined with SAN Volume Controller, can increase storage performance as much as 2x.

To help deliver performance with valuable storage services and functionality, FlashSystem 840 integrates with SAN Volume Controller for centralized storage management, and IBM System Storage Easy Tier® technology for intelligent data placement. IBM FlashSystem 840 also features an intuitive GUI design, reducing installation and management time by as much as 4.8X as compared to the prior generation GUI. FlashSystem 840 enables organizations to process vast amounts of data with high IOPS and bandwidth, helping speed time to market for products and services.

FlashSystem 840 benefits

Designed for businesses that demand mixed workload applications and require the ultimate in built-in, always-on high availability, FlashSystem 840 comes equipped with the latest interface technologies, a compact form factor, and terabytes of flash, all in a modular design to handle business growth. IBM FlashSystem 840 provides scalable performance for the most demanding enterprise class applications, including virtualized or bare-metal OLTP and OLAP databases, virtual desktop infrastructures, technical computing applications, and cloud environments. IBM FlashSystem 840 can accelerate response times with MicroLatency to enable faster decision making. FlashSystem 840 can either augment or replace hard disk drive storage systems to empower applications to work faster and scale further.

FlashSystem 840 products provide the following benefits:

- **Extreme performance**: Enable a business to unleash the power of performance, scale, and insight to drive services and products to market faster
- **MicroLatency:** Achieve competitive advantage through applications that enable faster decision-making because of microsecond response times
- **Macro Efficiency:** Decrease costs by getting more efficient usage of IT staff, IT applications, and IT equipment through the efficiencies flash storage brings to the data center
- **Enterprise reliability**: Durable and reliable designs that use enterprise class flash and patented data protection technology

Figure 2 illustrates the functions and features of IBM FlashSystem 840.

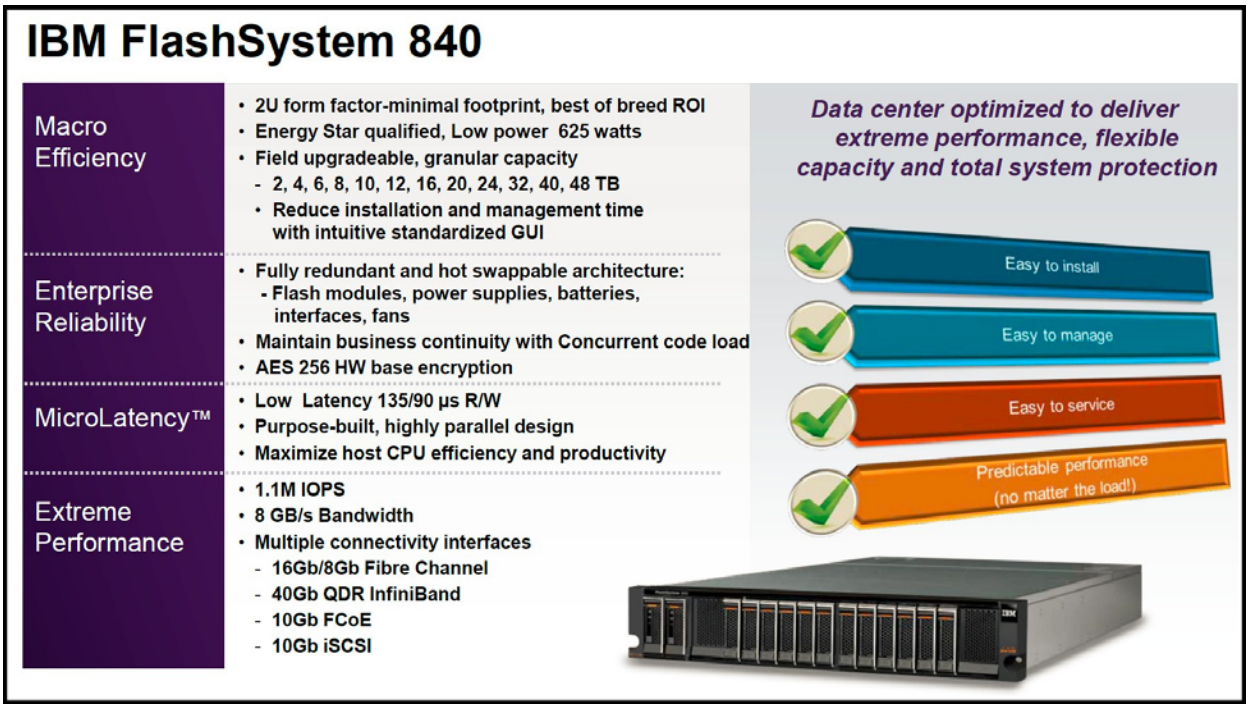

Figure 2. Introducing IBM FlashSystem 840

The following FlashSystem 840 features integrated with SAN Volume Controller help improve flexibility, scalability, performance, and investment protection:

- IBM MicroLatency provides latency that is measured in microseconds.
- High aggregate performance (bandwidth) and IOPS.
- Up to 16 ports of 8 Gbps for SAN Volume Controller support.
- RAID 5 configurations for reliability protects IBM FlashSystem 840 against an entire Flash Module failure.
- Configurable with 2 - 48 TB of usable capacity for increased flexibility.
- AES XTS 256 data-at-rest encryption for applications needing to safeguard valuable data.
- Always-on architecture with front accessible, hot-swap flash modules.
- An energy-efficient 2U form factor that is ideally suited for today's data center.

SAN Volume Controller benefits

You can use SAN Volume Controller products to add advanced storage functions to the extreme performance of FlashSystem 840. SAN Volume Controller products have a maximum of 100 µs of latency. When you combine FlashSystem 840 storage with SAN Volume Controller, you can take advantage of both IBM FlashSystem 840 and the IBM SAN Volume Controller features described below::

- Consolidation: Capacity from existing storage systems becomes part of the IBM storage system.
- Storage virtualization: Provides effective cloud deployment.
- IBM Easy Tier: Storage efficiency.
- IBM FlashCopy: Point-in-time copies.
- IBM Real-time Compression: Up to 5x more data in the same physical space.
- Thin provisioning: Allocates storage “just in time”.
- Data migration: Move data without disrupting applications.
- Business Continuity: Remote mirroring.
- Mirroring and Copy services: Data replication and protection

SAN Volume Controller compatibility

The SAN Volume Controller product supports a wide range of host operating systems, server platforms, Fibre Channel (FC) SAN switches, and storage controllers. An interoperability matrix for each SAN Volume Controller version is available at the following website:

http://www.ibm.com/systems/storage/software/virtualization/svc/interop.html

Solution overview

IBM FlashSystem 840 is all about being fast and purpose-built to minimize latency. For clients who want advanced software features, IBM FlashSystem 840 combined with SAN Volume Controller provides an enterprise-class solution by integrating the SAN Volume Controller functions and services, such as mirroring, Easy Tier, FlashCopy, thin provisioning, Real-Time Compression (RtC), and broader host support.

This solution includes one FlashSystem 840 that is virtualized by SAN Volume Controller, providing the performance of FlashSystem 840 capacity with the advanced functions of the SAN Volume Controller. This integration is used with EasyTier, with the SAN Volume Controller automatically promoting hot blocks to FlashSystem 840. The tiered storage solution efficiently uses FlashSystem 840 to increase performance in critical applications, and can reduce costs by migrating less critical data to less expensive media.

Figure 3 illustrates an overview of this solution architecture where IBM FlashSystem 840 is virtualized by SAN Volume Controller provisioning storage space for hosts. It also demonstrates how FlashSystem 840 can work with another storage subsystem within SAN Volume Controller to provide a tiered solution.

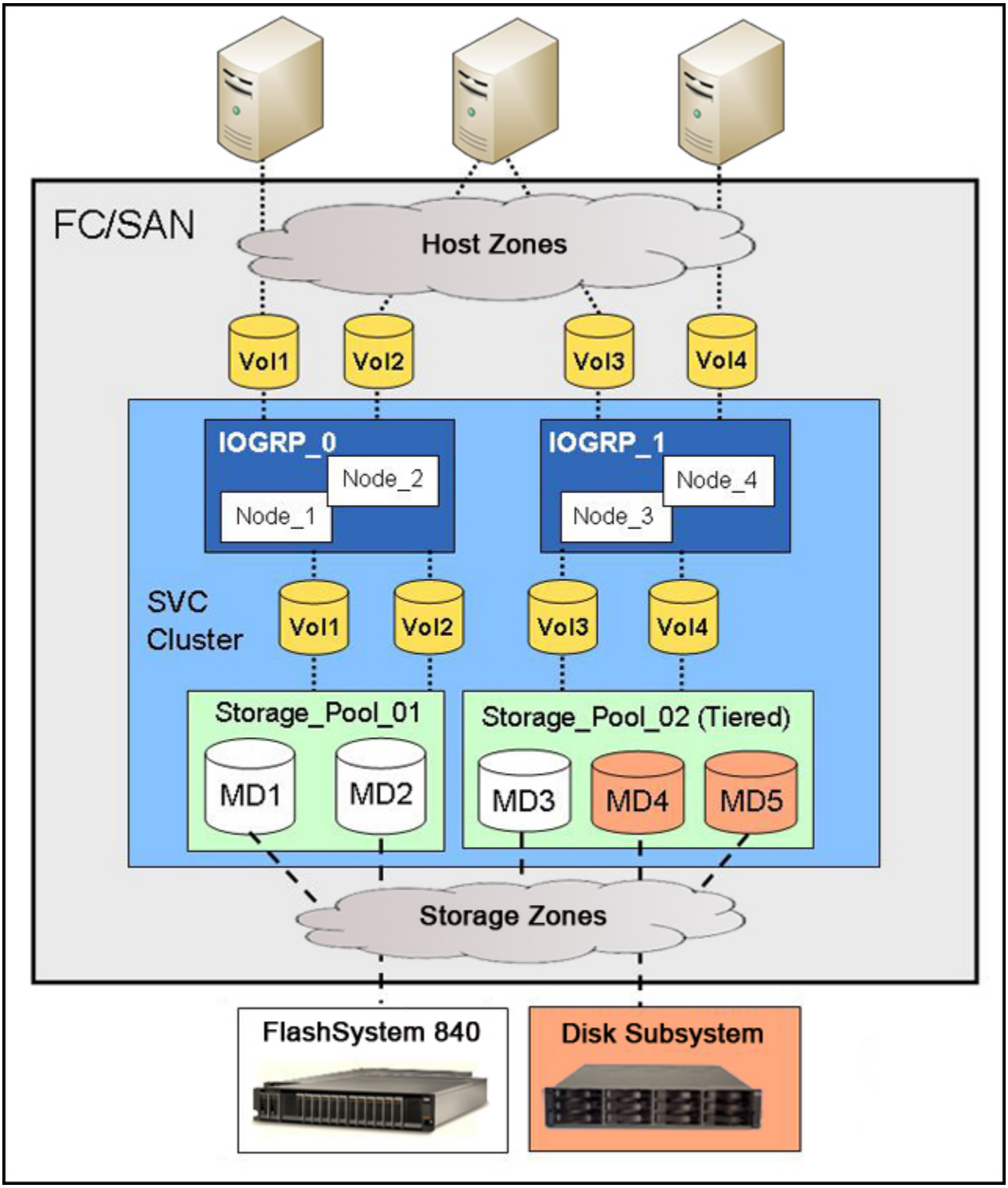

Figure 3. SAN Volume Controller architectural overview with a virtualized IBM FlashSystem 840

Solution architecture

IBM FlashSystem 840 supports connections to Fibre Channel SANs and can be zoned to act as back-end storage for SAN Volume Controller. You can take advantage of the 8 Gbps FC interfaces on FlashSystem 840 that can sustain a high-demand throughput and gain the benefits of the SAN Volume Controller functions by having FlashSystem 840 as Tier 0 storage. This solution architecture provides nondisruptive capacity scaling in two dimensions. Additional FlashSystem 840 systems can be added as Tier 0 capacity to maintain high IOPS performance, as well as additional HDD storage subsystems to add capacity for the Tiered SAN Volume Controller storage pool.

Figure 4, illustrates FlashSystem 840 virtualized by a SAN Volume Controller in a way that is similar to an auxiliary storage subsystem (Disk Subsystem) with HDD drives. There are two SAN Volume Controller Storage Pools: one (Storage_Pool_01) containing only FlashSystem capacity, and the other (Storage_Pool_02) containing both FlashSystem and HDD capacity to use the SAN Volume Controller Easy Tier function. Volumes Vol1 and Vol2 coming from the Storage_Pool_01 are FlashSystem volumes that are only being presented to hosts. Volumes Vol3 and Vol4 coming from the Storage_Pool_02 are mixed volumes (Flash + HDD) that provide storage capacity to the host, and use the SAN Volume Controller Easy Tier functionality.

Considerations when planning and configuring IBM FlashSystem 840 behind SAN Volume Controller

There are several considerations when you plan and configure your environment, including the MDisks and storage pools for IBM FlashSystem 840 behind SAN Volume Controller. Note the following points when you plan and design your environment and create MDisks for use in storage pools. In this case, queue and cache assignment is not as relevant as they are with traditional spindle-based disk systems because of the rapid speed at which IBM FlashSystem 840 can process I/O requests.

- Create one-to-one zone mappings for host HBA or SAN Volume Controller connections
- The maximum supported IBM FlashSystem 840 volume size is 2 TB (except when running SAN Volume Controller code 7.1.0.2 or higher), and the maximum number of MDisks per SAN Volume Controller cluster is 4096 MDisks. Use MDisks in multiples of four, which are an optimal number for CPU processing because the workload is equally distributed to the SAN Volume Controller processor cores.
- When you work with an all IBM FlashSystem 840 behind a SAN Volume Controller configuration, your storage pool extent size can be left at the default of 1024 KB (1 GB) because the performance of IBM FlashSystem 840 with random I/O workload does not require the extent size to be smaller.
- If you use FlashSystem 840 with the SAN Volume Controller Easy Tier function, you likely want to create multiple volumes for each hybrid storage pool. Create four or more volumes on FlashSystem 840 per hybrid pool, with the combined capacity of these volumes matching the capacity from FlashSystem 840 that you want for the SSD tier in that pool.

For more information about planning and configuring your IBM FlashSystem 840 within an SAN Volume Controller environment, see Chapter 8, "Product Integrations", in *Implementing IBM FlashSystem 840*, SG24-8189, found at the following website:

http://www.redbooks.ibm.com/abstracts/sg248189.html?Open

Easy Tier

The SAN Volume Controller Easy Tier function helps improve performance at a lower cost through more efficient usage of storage. Easy Tier is a performance function that automatically migrates or moves extents off a volume to, or from, one MDisk storage tier to another MDisk storage tier. Easy Tier monitors the host I/O activity and latency on the extents of all volumes with the Easy Tier function turned on in a multi-tier storage pool over a 24 hour period.

Easy Tier creates an extent migration plan based on this activity and then dynamically moves high activity or hot extents to a higher disk tier (in this case, FlashSystem 840) within the storage pool. It also moves extents whose activity dropped off or cooled from the high-tier MDisks back to a lower-tiered MDisk (in this case, disk storage).

SAN Volume Controller Easy Tier can deliver up to three times more performance improvement with only five percent flash storage capacity. Because the Easy Tier function is so tightly integrated, functions such as data movement, replication, and management all may be used with flash storage in the same way as for other storage. SAN Volume Controller helps move critical data to and from flash storage as needed without application disruptions. Combining SAN Volume Controller with FlashSystem storage devices delivers the best of both technologies: extraordinary performance for critical applications with IBM MicroLatency, coupled with sophisticated storage services functionality.

For more information about the IBM SAN Volume Easy Tier solution, go to the following website:

http://www.ibm.com/support/knowledgecenter/STPVGU_7.3.0/com.ibm.storage.svc.console.730.doc/svc_ichome_730.html

Usage scenarios

There are many usage scenarios where IBM FlashSystem 840 integrated with SAN Volume Controller is beneficial. Here are a few such scenarios.

Accelerating databases

Most database applications are highly read-intensive. As such, additional processing power alone does little or nothing to improve performance. By placing all read data on low latency flash memory, reads are performed much faster, boosting database performance over conventional disk systems with no tuning or changes to the code or system architecture.

IBM FlashSystem 840 integrated with SAN Volume Controller has the following capabilities:

- Decreases I/O wait time in enterprise workloads
- Delivers the lowest latency available on any SAN platform
- Accelerates commonly I/O-bound workloads, including transactional, batch, and complex analytics

SAP acceleration

Many SAP databases consume less than 2 TB of storage. SAP is pushing clients to accelerate performance by adopting the High Performance Analytic Appliance (HANA) in-memory database architecture. This adoption often leads to a significant re-architecture of the entire SAP infrastructure, which can result in higher costs and a risk of disruption in service delivery.

IBM FlashSystem 840 integrated with SAN Volume Controller has the following capabilities:

- Eliminates I/O bottlenecks in enterprise SAP workloads
- Provides the lowest latency of any SAN-based storage solution for time-sensitive workloads with IBM MicroLatency
- Enables a small, cost-effective pool of flash memory to deliver performance improvements
- Supports a phased approach to HANA adoption by delivering consistently higher performance for SAP NetWeaver Business Warehouse workloads with no re-architecture required.

Accelerating virtual servers and VDI

Virtual servers and virtual desktop infrastructures push conventional storage systems to their performance limits. The result is poor application response times and a bad customer experience. Virtualizing your environment by using IBM FlashSystem 840 integrated with SAN Volume Controller results in drastically faster response times for the most common virtualized applications. Couple this performance to the "log on" or "boot" storm and make system usage productive again.

IBM FlashSystem 840 integrated with SAN Volume Controller has the following capabilities:

- Virtualizes databases without performance loss
- Eliminates I/O density and hot-spot issues that are common to highly virtualized environments
- Controls and mitigates ‘log on’ or ‘boot’ storm performance issues
- Delivers storage consolidation without sacrificing performance

Midrange integration

IBM Storwize® V7000 can also be integrated in this solution and provide another level of tiering for the SAN Volume Controller and FlashSystem solution.

Storwize V7000 provides the following features:

- Provides SAN-attached 8 Gbps Fibre Channel (FC) host connectivity and 10 Gigabit Ethernet (GbE) and Gigabit iSCSI host connectivity
- Accommodates up to twenty-four 2.5-inch disk drives or twelve 3.5-inch disk drives that are installed within the IBM Storwize V7000 Control Enclosure, with attachment support for up to nine IBM Storwize V7000 Expansion Enclosures, providing modular and highly scalable storage solutions that range up to 240 TB physical storage capacity, and 480 TB physical storage capacity in a clustered system
- Supports intermixing of SAS drives, Nearline SAS drives, and solid-state drives within IBM Storwize V7000 Control Enclosures and IBM Storwize V7000 Expansion Enclosures
- Includes Easy Tier technology for automatically moving heavily used data extents onto high-performance SSD storage
- Supports attachment of other storage devices through the Fibre Channel interface, just like the SAN Volume Controller
- Supports a complete set of SAN Volume Controller functions, including FlashCopy, RemoteCopy, Volume Mirroring, and thin provisioning

Supported platforms

For the latest information about supported systems and platforms, see the IBM System Storage Interoperation Center (SSIC) at the following website:

http://www.ibm.com/systems/support/storage/ssic/interoperability.wss

Ordering information

FlashSystem storage products can be ordered as (IBM FlashSystem 840) or the IBM FlashSystem V840 Enterprise Performance Solution (FlashSystem V840) may be ordered to provide advanced functionality, such as thin provisioning, IBM Easy Tier, FlashCopy, and Real-time Compression.

For FlashSystem ordering information, see the following IBM Redbooks® Product Guides:

- *IBM FlashSystem 840 Product Guide*, TIPS1079
  http://www.redbooks.ibm.com/abstracts/tips1079.html
- IBM FlashSystem V840 Enterprise Performance Solution, TIPS1158
  http://www.redbooks.ibm.com/abstracts/tips1158.html

Related information

For more information, see the following resources:

- IBM FlashSystem family product page
  http://www.ibm.com/storage/flash
- *Implementing IBM FlashSystem 840*, SG24-8189-01
  http://www.redbooks.ibm.com/abstracts/sg248189.html?Open
- IBM System Storage SAN Volume Controller product page
  http://www.ibm.com/systems/storage/software/virtualization/svc/
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- IBM FlashSystem 840 Knowledge center
  http://www.ibm.com/support/knowledgecenter/ST2NVR_1.2.0/
- IBM System Storage Interoperation Center (SSIC)
  http://www.ibm.com/systems/support/storage/ssic/interoperability.wss
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